

AD-A105 145

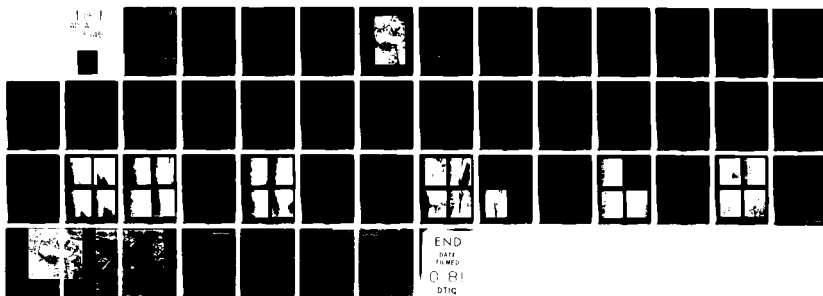
REITZ AND JENS INC ST LOUIS MO  
NATIONAL DAM SAFETY PROGRAM. LAND OF LAKES DAM (MO 30451), MISS--ETC(U)  
NOV 78 H M REITZ, J J BAILEY

F/G 13/13

DACW43-78-C-0162

NL

UNCLASSIFIED



LEVEL



# MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

LAND OF LAKES DAM

JEFFERSON COUNTY, MISSOURI

MO 30451

AD A105145

15  
DACW43-78-C-0162

9, Final rept.,

11 Nov 78

10/ Henry M. /Reitz John J. /Bailey, Jr/

## PHASE 1 INSPECTION REPORT

## NATIONAL DAM SAFETY PROGRAM

Land of Lakes Dam (MO 30451),  
Mississippi - Kaskaskia - St. Louis Basin,  
Jefferson County, Missouri. Phase I  
Inspection Report.



12 51

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DTIC  
ELECTE

OCT 7 1981

D

NOVEMBER 1978

DISTRIBUTION STATEMENT A

Approved for public release,  
Distribution Unlimited

81 10 7 079

412 576

FILE COPY

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. <div style="text-align: center; font-size: 1.2em;">AD-A105145</div>	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lake of Lakes Dam (MO 30451) Jefferson County, Missouri		5. TYPE OF REPORT & PERIOD COVERED <div style="text-align: center;">Final Report</div>
7. AUTHOR(s) Reitz & Jens, Inc.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		8. CONTRACT OR GRANT NUMBER(s) <div style="text-align: center;">DACW43-78-C-0162 ✓</div>
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE November 1978
		13. NUMBER OF PAGES Approximately 35
		15. SECURITY CLASS. (of this report) <div style="text-align: center;">UNCLASSIFIED</div>
16. DISTRIBUTION STATEMENT (of this Report)  Approved for release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		



DEPARTMENT OF THE ARMY  
ST. LOUIS DISTRICT, CORPS OF ENGINEERS  
210 NORTH 12TH STREET  
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Land of Lakes Dam, Missouri ID No. 30451  
Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Land of Lakes Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 45 percent of the Probable Maximum Flood
- 2) Overtopping could result in dam failure.
- 3) Seepage at the toe could result in dam failure.
- 4) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY:

SIGNED

Chief, Engineering Division

19 MAR 1979

Date

APPROVED BY:

SIGNED

Colonel, CE, District Engineer

20 MAR 1979

Date

Approved For	
NTIC 03241	
DTIC TAB <input checked="" type="checkbox"/>	
Unannounced <input type="checkbox"/>	
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

DTIC  
ELECTE  
OCT 7 1981  
D

## PHASE I REPORT

### NATIONAL DAM SAFETY PROGRAM

Name of Dam	Land of Lakes Dam
State Located	Missouri
County Located	Jefferson County
Stream	Unnamed Tributary of Bear Creek
Date of Inspection	15, 17, 24 and 29 November 1978

Land of Lakes Dam was inspected by an interdisciplinary team of engineers from Reitz & Jens, Inc. under contract with the St. Louis District Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations and private engineers. Based on these guidelines this dam is classified as a small dam with a high downstream hazard potential. The estimated damage zone from failure of the dam extends three miles downstream from the dam.

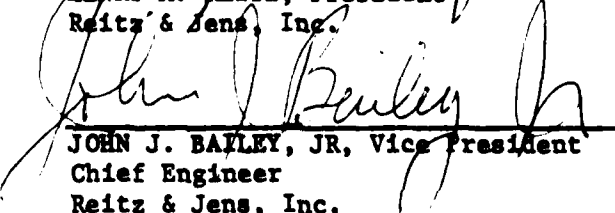
Failure would threaten the life and property of twenty-five families and cause appreciable damage to three improved roads.

Our inspection and evaluation indicates that the dam is deficient in that the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Considering the volume of water impounded, the small floodplain downstream and the 25 buildings downstream, the Probable Maximum Flood (PMF) is the appropriate spillway design flood. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions reasonably possible in the region. The dam will begin to be overtopped by a flood having a discharge (peak and volume) equal to 45% of the PMF. The spillways will pass a 1% chance flood (100-year flood) without overtopping which is a flood that has a 1% chance of being exceeded in any given year.

Other deficiencies noted by the inspection team were underseepage or seepage at the base of the dam embankment and heavy growth of trees and shrubs on the downstream slope of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

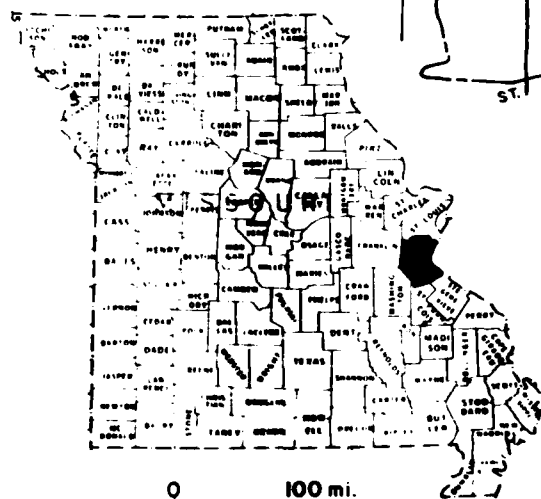
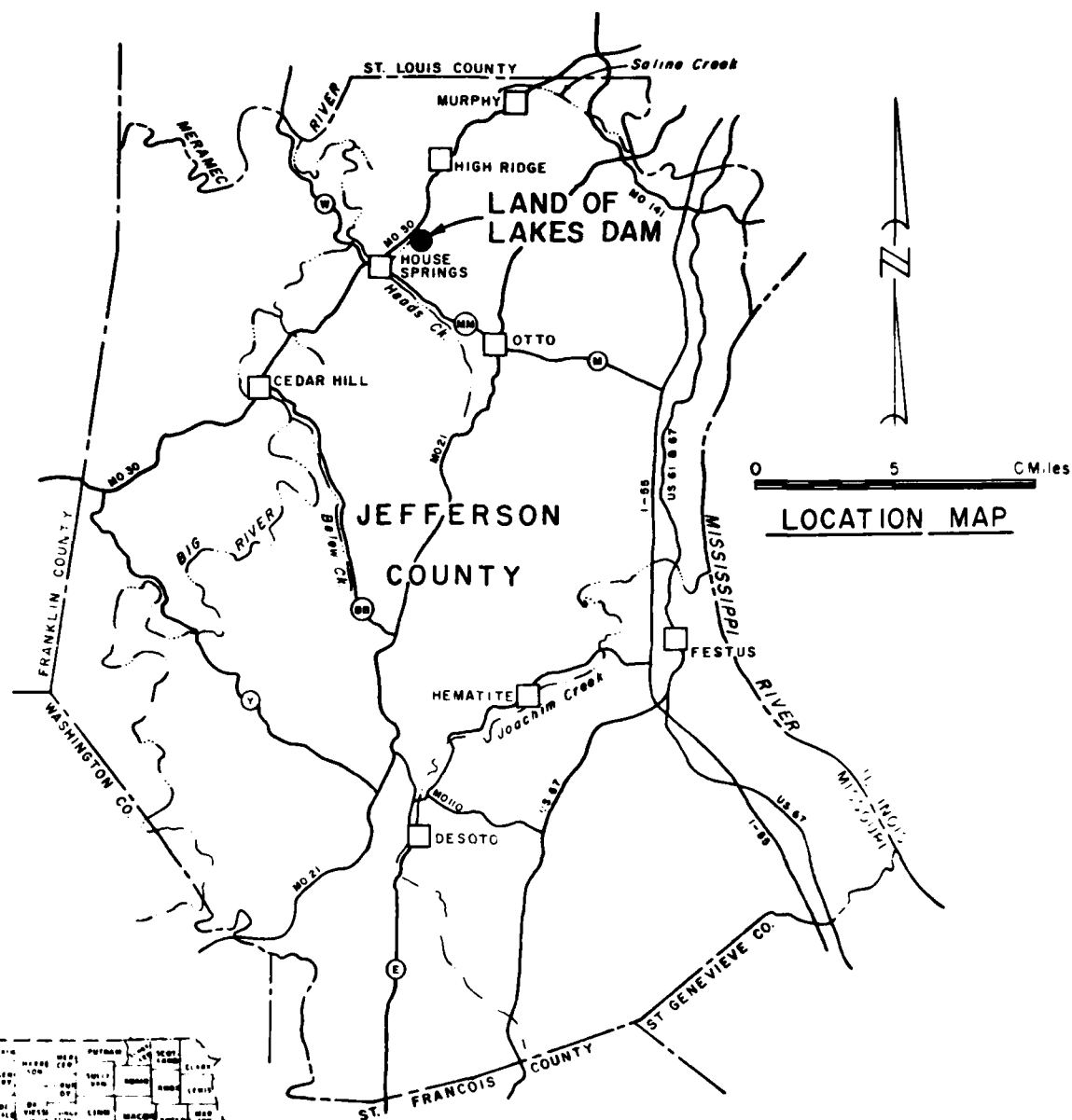
We recommend the owner take immediate action to correct or control the deficiencies described. A detailed discussion of each deficiency is included in the following report.

  
HENRY M. REITZ, President  
Reitz & Jens, Inc.

  
JOHN J. BAILEY, JR., Vice President  
Chief Engineer  
Reitz & Jens, Inc.



OVERVIEW-30451



PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
Land of Lakes Dam, MO ID No. 30451

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
SECTION 1 - PROJECT INFORMATION		
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	2
SECTION 2 - ENGINEERING DATA		
2.1	Design	4
2.2	Construction	4
2.3	Operation	4
2.4	Evaluation	4
SECTION 3 - VISUAL INSPECTION		
3.1	Findings	5
3.2	Evaluation	6
SECTION 4 - OPERATIONAL PROCEDURES		
4.1	Procedures	7
4.2	Maintenance of Dam	7
4.3	Maintenance of Operating Facilities	7
4.4	Description of Any Warning System in Effect	7
4.5	Evaluation	7
SECTION 5 - HYDRAULIC/HYDROLOGIC		
5.1	Evaluation of Features	8
SECTION 6 - STRUCTURAL STABILITY		
6.1	Evaluation of Structural Stability	9
SECTION 7 - ASSESSMENT/REMEDIAL MEASURES		
7.1	Dam Assessment	10
7.2	Remedial Measures	10
APPENDIX		
A	Hydrologic Computations	



TABLE OF CONTENTS  
(Cont.)

LIST OF PLATES

<u>Plate No.</u>	<u>Title</u>
1	Overview - Lake and Environs
2	Location and Vicinity Map
3	Plan and Profile Sheet (in pocket on back cover)
A-1 (5 sheets)	Hydrologic and Hydraulic Computations (HEC-1 Input and Output)

LIST OF INDICES AND PHOTOGRAPH NUMBERS

<u>Index No.</u>	<u>Title</u>
1	Index of Dam Photos (D-1 through D-8)
2	Index of Panorama Photos (P-1 through P-4)
3	Index of Spillway Photos (S-1 through S-5)
4	Index of Valley Below Dam Photos (V-1 through V-3)
5	Index of Seepage Photos (SE-1 through SE-4)

## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

a. Authority The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer contracted with Reitz & Jens, Inc. (Contract DACW43-78-C-0162) for a safety inspection of the Land of Lakes Dam, MO ID No. 30451.

b. Purpose of Inspection The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations and private engineers.

### 1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances The dam is an earth structure built across a draw in the hills on the southeast side of the Bear Creek valley. The drainage area consists of a narrow "V" valley with steeply sloping sides rising to rounded ridges. The steeper slopes, consisting of about 50% of the drainage area, are wooded. The rounded ridges were once cultivated but are now fallow and are in the process of low-density residential development. The general soil type in the watershed is Union Silt Loam. The dam axis runs generally north-south. The spillway is a concrete paved channel at the south abutment of the dam. There is a fairly wide berm between the spillway and the adjoining road ditch to the south. This berm can overflow into the road ditch at higher spillway discharges. A subdivision access road crosses the valley below the dam. This road traverses completely around the lake to serve 8 or 9 houses with lake access on their rear lot lines.

Topography in the vicinity of the dam is shown on Plate 3.

Pertinent physical data are given in paragraph 1.3 below.

b. Location The dam is located in north central Jefferson County about one and one-fourth miles northeast of House Springs as shown on Plate 2. The dam and lake are located in the SW $\frac{1}{4}$  of the NW $\frac{1}{4}$  of Section 35, T43N, R4E, and are shown on the Jefferson County Missouri, House Springs Quadrangle Sheet, 1954 Edition.

c. Size Classification Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1.c above. Based on these criteria, this dam and impoundment is in the small size category.

d. Hazard Classification Guidelines for determining hazard classification are presented in the same guidelines referenced in paragraph c above.

Based on referenced guidelines this dam is in the High Hazard Classification.

e. Ownership The dam is owned by the Land of Lakes Improvement Association. The trustees are: Paul Vanderhock, Jimmy L. Rathbers, Margaret Dodge. The address of record is Route 3, Box 145, House Springs, Missouri, 63051.

f. Purpose of Dam The dam forms a 2.7-acre recreational lake.

g. Design and Construction History The inspection team was unable to find any design data on this dam. Records on file in the county seat refer to the dam. One of these is dated July 1946 and was filed by H. Glenn Weber President of Weber Realty Co. Another is dated January 1971 and transfers the lake from Jefferson County Development Co. to the Land of Lakes Improvement Association, Inc. An unsuccessful attempt was made to contact the original owner in search of design and/or construction data.

h. Normal Operating Procedure Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation. The maximum water depth ever experienced at the spillway is unknown.

### 1.3 PERTINENT DATA

a. Drainage Area - 69 acres.

b. Discharge at Damsite

(1) All discharge at the damsite is through an uncontrolled spillway.

(2) Estimated experienced maximum flood at damsite - unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation - 394 cfs.

c. Elevation (Feet Above M.S.L.)

(1) Top of dam - 539.4 to 540.4 (see Plate 3).

(2) Spillway crest - 536.15

(3) Streambed at centerline of dam - 510+ (est.)

(4) Maximum tailwater - unknown.

d. Reservoir Length of maximum pool - 700 feet.

e. Storage (Acre Feet)

(1) Top of dam - 36 acre feet.

(2) Spillway crest - 26 acre feet.

f. Reservoir Surface (Acres)

(1) Top of dam - 3.1 acres

(2) Spillway crest - 2.7 acres.

g. Dam

- (1) Type - earth embankment
- (2) Length - 320 feet
- (3) Height - 30+ feet maximum (from survey).
- (4) Top width - 10+ feet.
- (5) Side Slopes -
  - (a) Downstream - 1V on 2.4H (determined from section at Station 2+25, see Plate 3).
  - (b) Upstream - 1V on 3H to water surface at Station 2+25.
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - None

i. Spillways Earth channel with concrete bottom at south end of dam.

j. Regulating Outlets - None

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

No design data were found to be readily available.

### 2.2 CONSTRUCTION

Apparently, the dam was constructed prior to 1946(see paragraph 1.2.g).

### 2.3 OPERATION

The maximum loading on the dam is unknown. The lake level seems to remain fairly stable despite some seepage through or under the dam during average precipitation of 38 inches per year. There are no records of operation of the dam.

### 2.4 EVALUATION

a. Availability No engineering data were available.

b. Adequacy The engineering data available were inadequate to make a detailed assessment of design, construction and operation. The owner should have an engineer, experienced in the design of dams, perform detailed seepage and stability analyses.

However, for the size of dam, materials used and measurements taken, a satisfactory hydrologic/hydraulic evaluation resulted. Also, for the section and presence of the primary spillway plus the visual inspection of a dam with reservoir of at least 30 years of age, the general condition of the dam, when considered by the experienced engineers, indicated that even though a detailed assessment of the design and construction in an analytical sense was not possible, a defensible evaluation of the dam as a structure, was feasible.

c. Validity This report is primarily for safety through maintenance and operation and the conclusions and evaluation for the Phase I Inspection are considered adequate for the definitive statement in this report.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

a. General A visual inspection of the Land of Lakes Dam was made on 29 November 1978. This followed three days of field measurements by a survey party on 15, 17 and 24 November 1978. The training and experience of personnel in these inspections included hydrologic/hydraulic engineering, soils and materials engineering, surveying and structural engineering. This section only states those aspects visually observed during the inspections. It does not comment upon items which may have been installed but were not evident during the field work.

b. Dam The dam is an earth dam. Top width - 10 feet. Downstream slope - 1V to 2.4H; upstream slope to water surface - 1V to 3H. Height of dam - 24 feet. In its 350 feet of length, the top of dam varies approximately one foot in elevation.

There is no erosion protection on the reservoir side of the dam (D-1, D-3, D-4). At and into the waterline, there is a series of tree stumps approximately 8 to 15 inches in diameter that clearly indicate that at some time in the past there had been large tree growth on the lake side of the dam (D-1, D-3, D-4, D-8). The surface of the dam is in grass that is well maintained on the top and lake sides (D-1, D-3, D-4, D-8). There are two locations in which shallow sloughs or other disturbance of the otherwise uniform upstream slope of the dam are visible (D-4). The downstream slope of the dam is covered by heavy underbrush and sapling growth (D-1, D-2, D-5, D-6, D-7).

Inspection of the downstream slope of the dam indicated seep water ponding, which appears to be either underseepage or at the original ground contact (SE-1, SE-2, SE-3) which, through a surface channel, connects to a natural draw below the dam (SE-4).

c. Spillways There is no indication of a primary pipe spillway. An emergency open spillway is on the south end of the dam which has been lined with Portland cement concrete (S-3, S-4, S-5) that does not appear to have been placed to any geometric section. It is paved 18 feet wide for a length of 50 feet to where its grade breaks downslope (S-3) from which there is a narrower, slushed concrete section (S-1). The concrete lining is carried to the bottom of the dam where some broken rubble has been piled off to the side (S-2). The spillway alignment, in its upper part, appears to be in virgin soil but not on a bedrock exposure at the base of the concrete. As it carries water downslope, at least a part of the alignment appears to be in earth fill. The controlling vertical distance between the elevation on the concrete in the spillway and the top of the dam is 4 feet.

d. Reservoir The lake behind the dam and in the southeast, east and northeast (P-2, P-3, P-4) has a steep bank with the "rolling" being the flattest portions of the embankment adjoining the north and south ends of the dam (P-1). The southeast third of the edge at the lake is still in woods (P-2). Other portions are residential yards with grass extending down to the edge of the water (P-1, P-3, P-4). There is a rock ledge exposed in the eastern edge of the lake (P-2, P-3).

e. Valley Below the Dam Within 200 feet of the centerline of the dam is an asphaltic surfaced road (V-1, V-3). A short distance downstream from the road, a single-family subdivision occupies the valley floor (V-1, V-2). The channel carrying the flow over the spillway, after crossing under the road, travels along the south side of the valley behind the southernmost row of houses in the indicated subdivision.

### 3.2 EVALUATION

The high degree of development in close proximity downstream from the dam, the inadequate capacity of the only spillway, the low difference between the control elevation of the spillway and the intermediate low point on the dam crest, the existing tree and shrub growth on the dam and the underseepage or seepage water standing at the toe of the dam jointly indicate need for immediate remedial action to eliminate a serious potential of failure.

The tree growth and shrubs on the downstream face of the dam should be removed and turf established. Trees and shrubs provide shelter and habitat for rodents whose burrowing activity might cause detrimental additional seepage. Furthermore, as the trees die or are cut, as occurred on the lake side, seepage through the embankment or sloughing may occur as roots decay.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

There are no controlled outlet works for this dam; therefore, no regulating procedures exist. The pool is controlled by rainfall, runoff, evaporation and capacity of the uncontrolled spillway and, to some small extent, by seepage under and/or through the dam.

### 4.2 MAINTENANCE OF DAM

Based on the amount of brush and size of trees on the downstream slope, there has been inadequate attention given to mowing the slopes. It appears that the spillway has been recently paved with concrete apparently in response to erosion and degradation of the crest with resulting lower lake levels. No work seems to have been performed either in attempt to stop the seepage described in paragraph 3.1.b or to provide protective construction to control its effect on the dam embankment.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

### 4.5 EVALUATION

If the uncontrolled seepage and vegetation on the downstream slope is allowed to continue, a serious potential of failure may develop.



## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

a. Design Data No design data were found to be readily available.

b. Experience Data The drainage area is developed from USGS House Springs Missouri Quadrangle. Also available are 1"=2000' aerial stereo pairs taken 9 April 1977, by Surdex Corporation. Lake area is measured on a 1"=200' enlargement of a portion of one of these photographs and shown on Plate 1. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations

(1) The spillway and exit channel are located at the south end of the dam.

(2) Concrete spillway lining and the exit channel are in fairly good condition.

(3) No drawdown facilities are available to evacuate the pool.

(4) Maximum spillway releases will not endanger the integrity of the dam (see paragraph 3.2.b, paragraph 1.2.a and paragraph 4.2).

d. Overtopping Potential The spillway is too small to pass the required probable maximum flood without overtopping. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions reasonably possible in the region. The dam will start to be overtopped by a flood equal to 45% of the PMF. The PMF will overtop the dam to a maximum depth of about 1.3 feet. Maximum rate of flow over the dam crest will be about 500 cubic feet per second. Overtopping flow will have a duration of about 0.8 hours. The existing lake and spillway will contain a 100-year frequency flood below the crest of the dam.

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, the 100-year frequency flood is only adequate for a low hazard dam of small size.

The effect from rupture of the dam could extend approximately three miles downstream of the dam. There are 25 inhabited homes within one-half mile downstream of the dam which could be severely damaged and lives of the inhabitants could be lost should failure of the dam occur.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations Visual observations which adversely affect the structural stability of this dam are discussed in Section 3, paragraph 3.1.b.

b. Design and Construction Data No design or construction data relating to the structural stability of the dam were found.

c. Operating Records No appurtenant structures requiring operation exist at this dam.

d. Post Construction Changes No post construction changes other than the paving of the spillway with slushed concrete lining described in paragraph 3.1.c exist which will affect the stability of the dam.

e. Seismic Stability Considering the seismic zone (2) in which this dam is located, an earthquake of this magnitude is not expected to cause a structural failure of this dam.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety The spillway is inadequate to pass the required Probable Maximum Flood (PMF). The reservoir and principal spillway are adequate to contain a flood which has a 1% chance of being exceeded (100-year flood) in any given year.

Several items were noted during the visual inspection by the inspection team which should be corrected or controlled. The heavy growth of trees and shrubs on the downstream slope of the dam is a safety deficiency. Underseepage or seepage along the contact between the base of the dam and natural soil could lead to failure of the dam by piping or sloughing of the embankment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

b. Adequacy of Information Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers these data sufficient to support the conclusions herein.

c. Urgency The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the safety deficiencies listed in paragraph a are not corrected in the near future, they will continue to deteriorate and lead to a serious potential of failure.

d. Necessity for Phase II Based on the results of the Phase I Inspection no Phase II Inspection is recommended.

e. Seismic Stability This dam is located in Seismic Zone 2. An earthquake of this magnitude is not expected to be hazardous to this dam.

### 7.2 REMEDIAL MEASURES

a. The owner should obtain the services of an experienced engineer to design and observe construction of the following remedial measures. These services would include preparation of stability and seepage analyses as part of the design of item (3) below.

(1) Spillway size and/or height of dam should be increased to pass the Probable Maximum Flood without overtopping the dam. In either case, the spillway should be protected to prevent erosion.

(2) The tree and shrub growth on the downstream face of the dam should be removed, the stumps and roots grubbed out and the slope should be dressed, seeded, fertilized and mulched to establish turf that can be mowed.

(3) Underseepage or seepage along the contact between the dam embankment and natural ground should be stopped or protective construction should be installed to prevent loss of embankment or base material by piping.

b. O&M Maintenance and Procedures    The following O&M maintenance and procedures are recommended:

(1) After removal of existing tree growth, vegetation on the dam should be periodically cut.

(2) After completion of the remedial measures, detailed inspections of the dam should be made periodically by an engineer experienced in the design and construction of dams. Records should be kept of these inspections and major maintenance.

APPENDIX A  
HYDROLOGIC CALCULATIONS

## HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation for those dams in the high hazard potential category is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33". Reduction factors have not been applied. A 24-hour storm duration is assumed with the 24-hour rainfall depths distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use and antecedent moisture conditions.
2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the spillway and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-area curve. The hydraulic capacity of the spillway and the nearly level crest of dam is defined by a composite elevation discharge curve.
3. Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.
4. The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed on Plate 1A. Definitions of these variables are contained in the "User's Manual" for the computer program.
5. The discharge in the spillway was calculated using critical depth at the control sections near where the dam centerline crosses the spillway channel, allowing 0.2 velocity head for non-uniform velocity distribution, velocity transition losses and friction in the short approach. At low flows this control is at a section running at a 45-degree angle upstream from Station 1+50. At higher flows this moves downstream to the axis of the dam.
6. Flow over the top of dam was calculated using a level crest and a discharge coefficient of 3.0 in the broad-crested weir equation. A correction was made for the short, lower section of the dam where overtopping flow starts. All spillway and overtopping discharge was included in a composite rating curve. Dummy values of 0.1 for dam length, coefficient of discharge and exponent were entered on the SD card to suppress diagnostic statements in the output. The amount of this dummy flow is never greater than 0.02 cfs.

\*\*\*\*\*  
FLOOD HYDROGRAPH PACKAGE (HFC-1)  
DAM SAFETY VERSION JULY 1978  
LAST MODIFICATION 3 AUG 78  
\*\*\*\*\*

1	A	*****	10	#	30451	LAND	OF	LAKES	DAM	#	AND	435	FOR	USGS	ELFV	****
2	A	*****	DAM	SAFETY	PROGRAM	-	U.	S.	CORPS	OF	ENGINEERS	*****				
3	A	*****	REIT7	#	JENS,	INC.	-	SEPTEMBER	1978	*****						
4	R	288	0	5	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0
5	I	5														
6	J	1	5	1												
7	J1	0.40	0.45	0.50	0.55	1.00										
8	K	0	PMF													
9	I	*****	INFLOW	HYDROGRAPH	-	SCS	METHOD	*****								
10	M	1	2	0.178												
11	O	1	25.5	111	120	130										
12	T															
13	42		0.17													
14	X		-0.20	2.0												
15	K	1	13													
16	I	*****	RESERVOIR	ROUTING	-	PIPE	#	SPLITWAY	EQUATIONS	-	LEVEL	DAM	*****			
17	Y															
18	Y1	1														
19	Y4	101.15	101.3	101.4	101.6	102.0	102.0	102.0	102.0	102.0	102.5	103.0	103.5	104.0		
20	Y4	104.4	104.8	105.0	105.5	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0		
21	Y5	0.0	0.4	1.5	5.7	24.0	45.7	45.7	45.7	45.7	60.0	127.0	240.0	309.0		
22	Y5	304.0	527.0	635.0	1048.0	1626.0	2392.0	2392.0	2392.0	2392.0	2392.0	2392.0	2392.0	2392.0		
23	EA	0.0	2.74	3.2	6.9											
24	SE	75	100	105	115											
25	SE	101.15														
26	SD	104.4	0.1	0.1	0.1											
27	K	90														

\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (HFC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 3 AUG 78  
 \*\*\*\*\*

RUN DATE 12/15/78.  
 TIME 14.43.43.

\*\*\*\*\* TO # 30451 LAND OF LAKES DAM \* ADD \*35 FOR USGS FLEV \*\*\*  
 \*\*\*\*\* DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS \*\*\*\*\*  
 \*\*\*\*\* RFIITZ & JENS. INC. - SEPTEMBER 1978 \*\*\*\*\*

JOB SPECIFICATION									
NO	NHR	NMIN	TDAY	IHR	IMIN	METPC	IPLT	IPRT	NSTAN
298	0	5	-0	-0	-0	-0	-0	-4	-0
			JOPER	NWT	LOOST	TDACE			
			5	-0	-0	-0			

MULTI-PLAN ANALYSES TO BE PERFORMED  
 MPLAN= 1 NRTO= 5 LRTIO= 1  
 DTIO= .40 .45 .50 .55 1.00

\*\*\*\*\* SUR-AREA RUNOFF COMPUTATION \*\*\*\*\*

\*\*\*\*\* INFLOW HYDROGRAPH - SCS METHOD \*\*\*\*\*

ISTAO	ICOMP	IFCON	ITAF	JPLT	JPRT	I-AME	ISTAGF	IAUTO
0	0	-0	-0	1	3	1	-0	-0

HYDROGRAPH DATA

IMYNG	IUMG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISMMW	ISAMF	LOCAL
1	2	.11	-0.00	.11	1.00	-0.000	-0	1	-0

PRECIP DATA

S-PF	PMS	PM	R12	R24	R48	R72	R96
-0.00	25.50	101.00	120.00	130.00	-0.00	-0.00	-0.00

LOSS DATA

LRPRT	STOKO	DLTKR	RTIOL	FRAIN	STOKS	RTIOK	STIRL	CNSTI	ALSMX	RTIMP
-0	-0.00	-0.00	1.00	-0.00	-0.00	1.00	-1.00	-05.00	-0.00	.05

CURVE NO = -05.00 WETNESS = -1.00 EFFECT CN = 05.00

UNIT HYDROGRAPH DATA

TC= -0.00 LAG= .17

RECESSION DATA

STOTO= -0.00 GRCSM= -.20 RTIOR= 2.00

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= -0.00 HOURS, LAG= .17 VOL= 1.00  
 75. 227. 233. 144. 73. 11. 6.  
 2. 1.

MO.DA	HR.MN	PERION	RAIN	EXCS	LOSS	COMP D	END-OF-PERIOD FLOW	HR.MN	PERION	RAIN	EXCS	LOSS	COMP D
0													



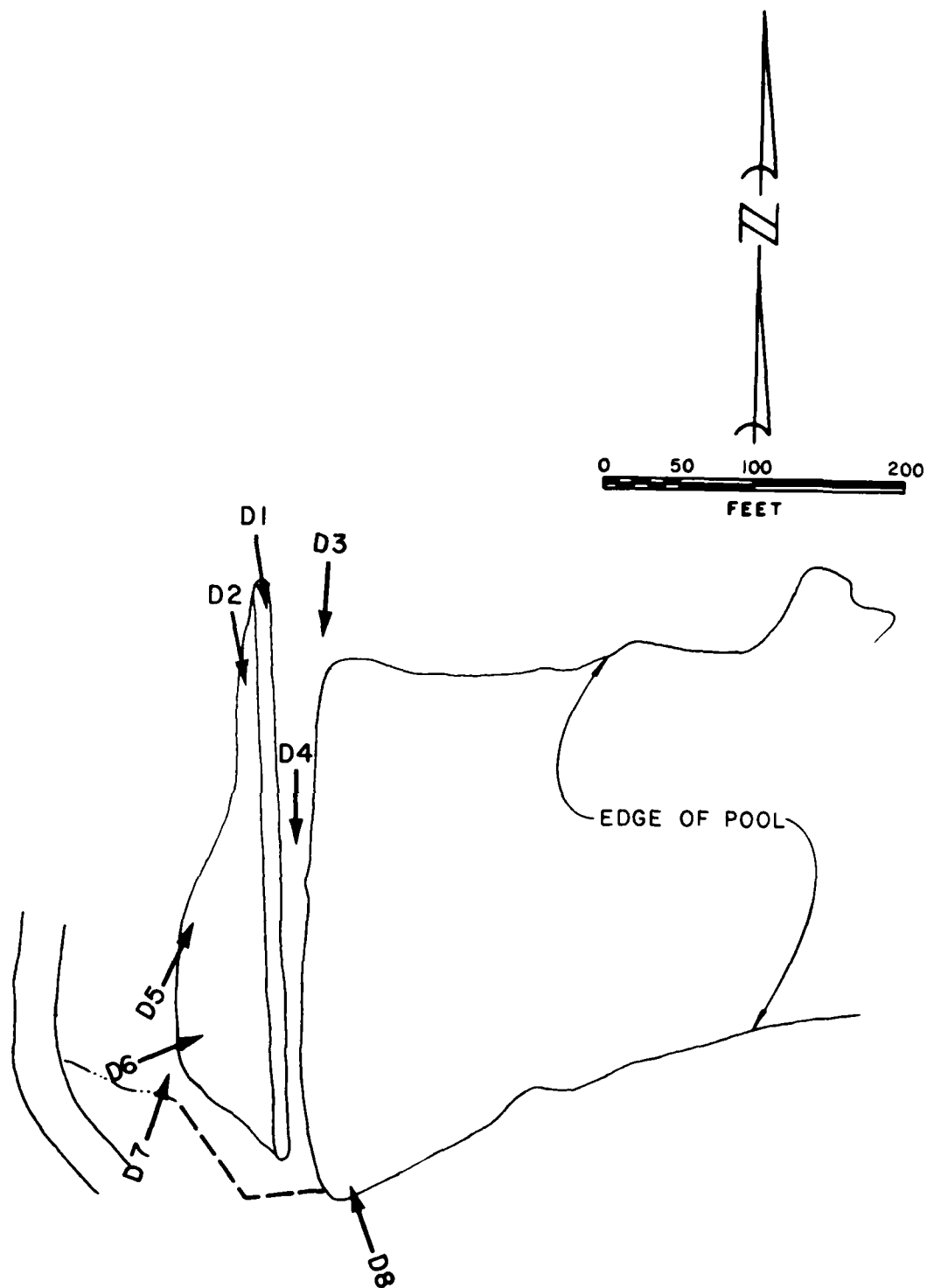
END-OF-PERIOD FLOW													
MO.DA	HR.MN	PERION	RATN	EXCS	LOSS	COMP 0	MO.DA	HR.MN	PERION	RATN	EXCS	LOSS	COMP 0
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.20	.01	63.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.21	.20	.01	95.
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.21	.20	.01	128.
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.21	.20	.01	149.
1.01	.25	5	.01	.00	.01	1.	1.01	12.25	149	.21	.21	.01	159.
1.01	.30	6	.01	.00	.01	1.	1.01	12.30	150	.21	.21	.01	165.
1.01	.35	7	.01	.00	.01	1.	1.01	12.35	151	.21	.21	.01	168.
1.01	.40	8	.01	.00	.01	1.	1.01	12.40	152	.21	.21	.01	170.
1.01	.45	9	.01	.00	.01	1.	1.01	12.45	153	.21	.21	.01	171.
1.01	.50	10	.01	.00	.01	1.	1.01	12.50	154	.21	.21	.01	172.
1.01	.55	11	.01	.00	.01	1.	1.01	12.55	155	.21	.21	.01	173.
1.01	1.00	12	.01	.00	.01	1.	1.01	13.00	156	.21	.21	.01	173.
1.01	1.05	13	.01	.00	.01	1.	1.01	13.05	157	.26	.25	.01	177.
1.01	1.10	14	.01	.00	.01	1.	1.01	13.10	158	.26	.25	.01	186.
1.01	1.15	15	.01	.00	.01	1.	1.01	13.15	159	.26	.25	.01	196.
1.01	1.20	16	.01	.00	.01	1.	1.01	13.20	160	.26	.25	.01	203.
1.01	1.25	17	.01	.00	.01	1.	1.01	13.25	161	.26	.25	.01	206.
1.01	1.30	18	.01	.00	.01	1.	1.01	13.30	162	.26	.25	.01	208.
1.01	1.35	19	.01	.00	.01	1.	1.01	13.35	163	.26	.25	.01	209.
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.26	.25	.01	210.
1.01	1.45	21	.01	.00	.01	1.	1.01	13.45	165	.26	.25	.01	210.
1.01	1.50	22	.01	.00	.01	1.	1.01	13.50	166	.26	.25	.01	211.
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.26	.25	.00	211.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.26	.25	.00	211.
1.01	2.05	25	.01	.00	.01	1.	1.01	14.05	169	.32	.32	.01	216.
1.01	2.10	26	.01	.00	.01	1.	1.01	14.10	170	.32	.32	.01	230.
1.01	2.15	27	.01	.00	.01	1.	1.01	14.15	171	.32	.32	.01	245.
1.01	2.20	28	.01	.00	.01	1.	1.01	14.20	172	.32	.32	.00	255.
1.01	2.25	29	.01	.00	.01	1.	1.01	14.25	173	.32	.32	.00	260.
1.01	2.30	30	.01	.00	.01	1.	1.01	14.30	174	.32	.32	.00	262.
1.01	2.35	31	.01	.00	.01	1.	1.01	14.35	175	.32	.32	.00	264.
1.01	2.40	32	.01	.00	.01	1.	1.01	14.40	176	.32	.32	.00	265.
1.01	2.45	33	.01	.00	.01	1.	1.01	14.45	177	.32	.32	.00	265.
1.01	2.50	34	.01	.00	.01	2.	1.01	14.50	178	.32	.32	.00	266.
1.01	2.55	35	.01	.00	.01	2.	1.01	14.55	179	.32	.32	.00	266.
1.01	3.00	36	.01	.00	.01	2.	1.01	15.00	180	.32	.32	.00	266.
1.01	3.05	37	.01	.00	.01	2.	1.01	15.05	181	.20	.19	.00	257.
1.01	3.10	38	.01	.00	.01	2.	1.01	15.10	182	.39	.39	.00	243.
1.01	3.15	39	.01	.00	.01	2.	1.01	15.15	183	.39	.39	.00	254.
1.01	3.20	40	.01	.00	.01	3.	1.01	15.20	184	.59	.59	.01	299.
1.01	3.25	41	.01	.00	.01	3.	1.01	15.25	185	.69	.69	.01	370.
1.01	3.30	42	.01	.00	.01	3.	1.01	15.30	186	1.66	1.66	.01	519.
1.01	3.35	43	.01	.00	.01	3.	1.01	15.35	187	2.72	2.72	.02	876.
1.01	3.40	44	.01	.00	.01	3.	1.01	15.40	188	1.07	1.07	.01	1253.
1.01	3.45	45	.01	.00	.01	3.	1.01	15.45	189	.69	.69	.00	1257.
1.01	3.50	46	.01	.00	.01	3.	1.01	15.50	190	.59	.59	.00	1013.
1.01	3.55	47	.01	.00	.01	3.	1.01	15.55	191	.39	.39	.00	766.
1.01	4.00	48	.01	.00	.01	4.	1.01	16.00	192	.39	.39	.00	585.
1.01	4.05	49	.01	.00	.01	4.	1.01	16.05	193	.30	.30	.00	460.
1.01	4.10	50	.01	.00	.01	4.	1.01	16.10	194	.30	.30	.00	372.
1.01	4.15	51	.01	.00	.01	4.	1.01	16.15	195	.30	.30	.00	316.
1.01	4.20	52	.01	.00	.01	4.	1.01	16.20	196	.30	.30	.00	285.
1.01	4.25	53	.01	.00	.01	4.	1.01	16.25	197	.30	.30	.00	268.
1.01	4.30	54	.01	.00	.01	4.	1.01	16.30	198	.30	.30	.00	259.
1.01	4.35	55	.01	.00	.01	4.	1.01	16.35	199	.30	.30	.00	254.
1.01	4.40	56	.01	.00	.01	4.	1.01	16.40	200	.30	.30	.00	252.
1.01	4.45	57	.01	.00	.01	4.	1.01	16.45	201	.30	.30	.00	251.
1.01	4.50	58	.01	.00	.01	5.	1.01	16.50	202	.30	.30	.00	250.
1.01	4.55	59	.01	.00	.01	5.	1.01	16.55	203	.30	.30	.00	250.
1.01	5.00	60	.01	.00	.01	5.	1.01	17.00	204	.30	.30	.00	250.

1.01	5.05	61	.01	.01	.01	5.	1.01	17.05	205	.24	.24	.00	246.
1.01	5.10	62	.01	.01	.01	5.	1.01	17.10	206	.24	.24	.00	231.
1.01	5.15	63	.01	.01	.01	5.	1.01	17.15	207	.24	.24	.00	216.
1.01	5.20	64	.01	.01	.01	5.	1.01	17.20	208	.24	.24	.00	207.
1.01	5.25	65	.01	.01	.01	5.	1.01	17.25	209	.24	.24	.00	202.
1.01	5.30	66	.01	.01	.01	5.	1.01	17.30	210	.24	.24	.00	199.
1.01	5.35	67	.01	.01	.01	5.	1.01	17.35	211	.24	.24	.00	198.
1.01	5.40	68	.01	.01	.01	5.	1.01	17.40	212	.24	.24	.00	197.
1.01	5.45	69	.01	.01	.01	5.	1.01	17.45	213	.24	.24	.00	197.
1.01	5.50	70	.01	.01	.01	6.	1.01	17.50	214	.24	.24	.00	197.
1.01	5.55	71	.01	.01	.01	6.	1.01	17.55	215	.24	.24	.00	197.
1.01	6.00	72	.01	.01	.01	6.	1.01	18.00	216	.24	.24	.00	197.
1.01	6.05	73	.07	.03	.03	8.	1.01	18.05	217	.02	.02	.00	184.
1.01	6.10	74	.07	.04	.03	14.	1.01	18.10	218	.02	.02	.00	171.
1.01	6.15	75	.07	.04	.03	21.	1.01	18.15	219	.02	.02	.00	160.
1.01	6.20	76	.07	.04	.03	26.	1.01	18.20	220	.02	.02	.00	149.
1.01	6.25	77	.07	.04	.03	29.	1.01	18.25	221	.02	.02	.00	139.
1.01	6.30	78	.07	.04	.03	31.	1.01	18.30	222	.02	.02	.00	130.
1.01	6.35	79	.07	.04	.02	33.	1.01	18.35	223	.02	.02	.00	121.
1.01	6.40	80	.07	.04	.02	36.	1.01	18.40	224	.02	.02	.00	114.
1.01	6.45	81	.07	.05	.02	36.	1.01	18.45	225	.02	.02	.00	105.
1.01	6.50	82	.07	.05	.02	37.	1.01	18.50	226	.02	.02	.00	98.
1.01	6.55	83	.07	.05	.02	37.	1.01	18.55	227	.02	.02	.00	92.
1.01	7.00	84	.07	.05	.02	38.	1.01	19.00	228	.02	.02	.00	86.
1.01	7.05	85	.07	.05	.02	39.	1.01	19.05	229	.02	.02	.00	80.
1.01	7.10	86	.07	.05	.02	40.	1.01	19.10	230	.02	.02	.00	75.
1.01	7.15	87	.07	.05	.02	40.	1.01	19.15	231	.02	.02	.00	70.
1.01	7.20	88	.07	.05	.02	41.	1.01	19.20	232	.02	.02	.00	65.
1.01	7.25	89	.07	.05	.02	42.	1.01	19.25	233	.02	.02	.00	61.
1.01	7.30	90	.07	.05	.02	42.	1.01	19.30	234	.02	.02	.00	57.
1.01	7.35	91	.07	.05	.01	43.	1.01	19.35	235	.02	.02	.00	54.
1.01	7.40	92	.07	.05	.01	43.	1.01	19.40	236	.02	.02	.00	49.
1.01	7.45	93	.07	.05	.01	44.	1.01	19.45	237	.02	.02	.00	46.
1.01	7.50	94	.07	.05	.01	44.	1.01	19.50	238	.02	.02	.00	43.
1.01	7.55	95	.07	.05	.01	45.	1.01	19.55	239	.02	.02	.00	40.
1.01	8.00	96	.07	.05	.01	45.	1.01	20.00	240	.02	.02	.00	37.
1.01	8.05	97	.07	.04	.01	45.	1.01	20.05	241	.02	.02	.00	35.
1.01	8.10	98	.07	.04	.01	46.	1.01	20.10	242	.02	.02	.00	32.
1.01	8.15	99	.07	.04	.01	46.	1.01	20.15	243	.02	.02	.00	30.
1.01	8.20	100	.07	.04	.01	46.	1.01	20.20	244	.02	.02	.00	28.
1.01	8.25	101	.07	.04	.01	47.	1.01	20.25	245	.02	.02	.00	26.
1.01	8.30	102	.07	.04	.01	47.	1.01	20.30	246	.02	.02	.00	25.
1.01	8.35	103	.07	.04	.01	47.	1.01	20.35	247	.02	.02	.00	23.
1.01	8.40	104	.07	.04	.01	48.	1.01	20.40	248	.02	.02	.00	21.
1.01	8.45	105	.07	.04	.01	48.	1.01	20.45	249	.02	.02	.00	20.
1.01	8.50	106	.07	.04	.01	48.	1.01	20.50	250	.02	.02	.00	19.
1.01	8.55	107	.07	.04	.01	48.	1.01	20.55	251	.02	.02	.00	18.
1.01	9.00	108	.07	.04	.01	49.	1.01	21.00	252	.02	.02	.00	18.
1.01	9.05	109	.07	.04	.01	49.	1.01	21.05	253	.02	.02	.00	18.
1.01	9.10	110	.07	.04	.01	49.	1.01	21.10	254	.02	.02	.00	18.
1.01	9.15	111	.07	.04	.01	49.	1.01	21.15	255	.02	.02	.00	18.
1.01	9.20	112	.07	.04	.01	50.	1.01	21.20	256	.02	.02	.00	18.
1.01	9.25	113	.07	.04	.01	50.	1.01	21.25	257	.02	.02	.00	18.
1.01	9.30	114	.07	.04	.01	50.	1.01	21.30	258	.02	.02	.00	18.
1.01	9.35	115	.07	.04	.01	50.	1.01	21.35	259	.02	.02	.00	18.
1.01	9.40	116	.07	.04	.01	50.	1.01	21.40	260	.02	.02	.00	18.
1.01	9.45	117	.07	.04	.01	50.	1.01	21.45	261	.02	.02	.00	18.
1.01	9.50	118	.07	.04	.01	50.	1.01	21.50	262	.02	.02	.00	18.
1.01	9.55	119	.07	.04	.01	51.	1.01	21.55	263	.02	.02	.00	18.
1.01	10.00	120	.07	.06	.01	51.	1.01	22.00	264	.02	.02	.00	18.

1.01	10.05	121	.07	.06	.01	51.	1.01	22.05	265	.02	.02	.00	18.
1.01	10.10	122	.07	.06	.01	51.	1.01	22.10	266	.02	.02	.00	18.
1.01	10.15	123	.07	.06	.01	51.	1.01	22.15	267	.02	.02	.00	18.
1.01	10.20	124	.07	.06	.01	51.	1.01	22.20	268	.02	.02	.00	18.
1.01	10.25	125	.07	.06	.01	51.	1.01	22.25	269	.02	.02	.00	18.
1.01	10.30	126	.07	.06	.01	51.	1.01	22.30	270	.02	.02	.00	18.
1.01	10.35	127	.07	.06	.01	52.	1.01	22.35	271	.02	.02	.00	18.
1.01	10.40	128	.07	.06	.01	52.	1.01	22.40	272	.02	.02	.00	18.
1.01	10.45	129	.07	.06	.01	52.	1.01	22.45	273	.02	.02	.00	18.
1.01	10.50	130	.07	.06	.01	52.	1.01	22.50	274	.02	.02	.00	18.
1.01	10.55	131	.07	.06	.00	52.	1.01	22.55	275	.02	.02	.00	18.
1.01	11.00	132	.07	.06	.00	52.	1.01	23.00	276	.02	.02	.00	18.
1.01	11.05	133	.07	.06	.00	52.	1.01	23.05	277	.02	.02	.00	18.
1.01	11.10	134	.07	.06	.00	52.	1.01	23.10	278	.02	.02	.00	18.
1.01	11.15	135	.07	.06	.00	52.	1.01	23.15	279	.02	.02	.00	18.
1.01	11.20	136	.07	.06	.00	52.	1.01	23.20	280	.02	.02	.00	18.
1.01	11.25	137	.07	.06	.00	52.	1.01	23.25	281	.02	.02	.00	18.
1.01	11.30	138	.07	.06	.00	53.	1.01	23.30	282	.02	.02	.00	18.
1.01	11.35	139	.07	.06	.00	53.	1.01	23.35	283	.02	.02	.00	18.
1.01	11.40	140	.07	.06	.00	53.	1.01	23.40	284	.02	.02	.00	18.
1.01	11.45	141	.07	.06	.00	53.	1.01	23.45	285	.02	.02	.00	18.
1.01	11.50	142	.07	.06	.00	53.	1.01	23.50	286	.02	.02	.00	18.
1.01	11.55	143	.07	.06	.00	53.	1.01	23.55	287	.02	.02	.00	18.
1.01	12.00	144	.07	.06	.00	53.	1.02	0.00	288	.02	.02	.00	18.
										33.15	31.22	1.93	27545.
										(842.)	(793.)	(49.)	779.991

## SUMMARY OF DAM SAFETY ANALYSIS

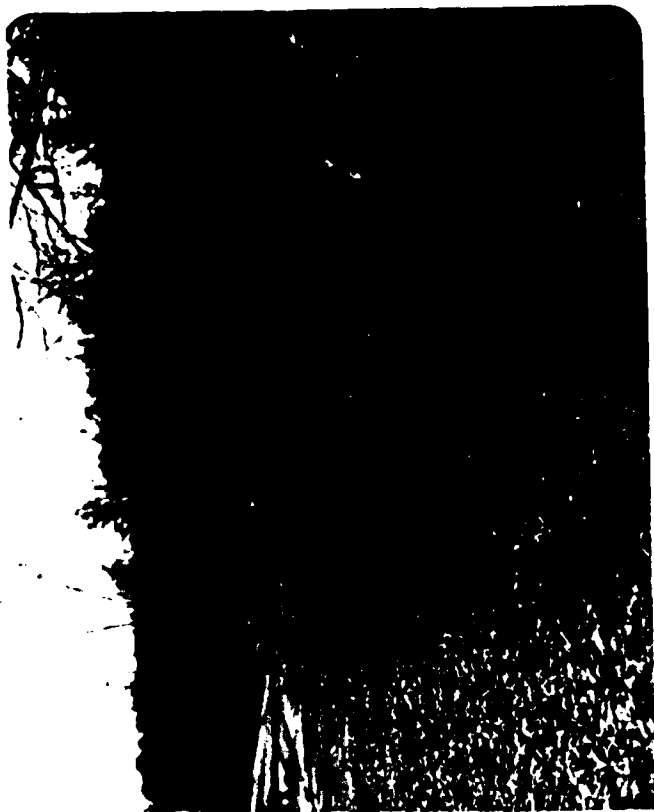
[illegible]



**PHOTO INDEX I  
FOR  
DAM**

**PREPARED BY  
REITZ & JENS, INC.**

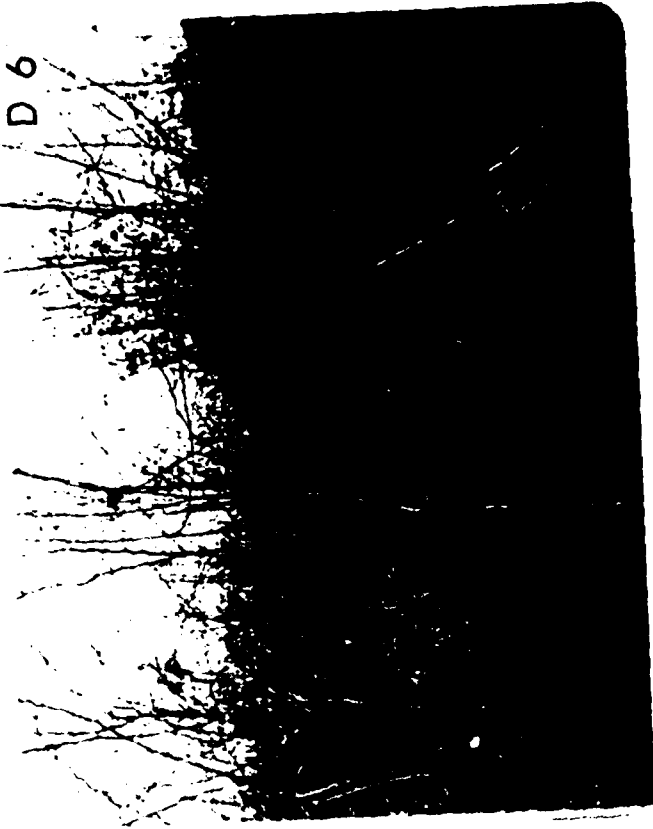
**LAND OF LAKES DAM  
JEFFERSON COUNTY, MO.  
DECEMBER 1978**



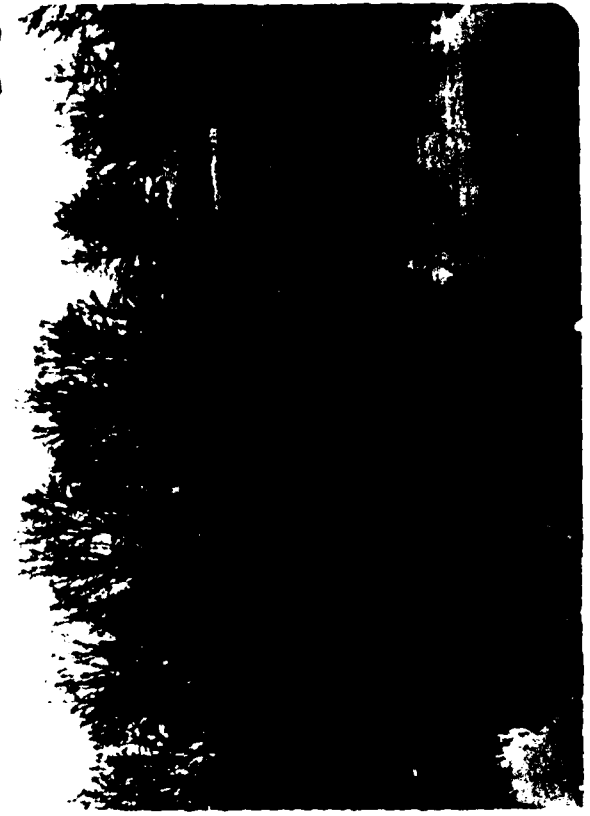
D 3

DAM

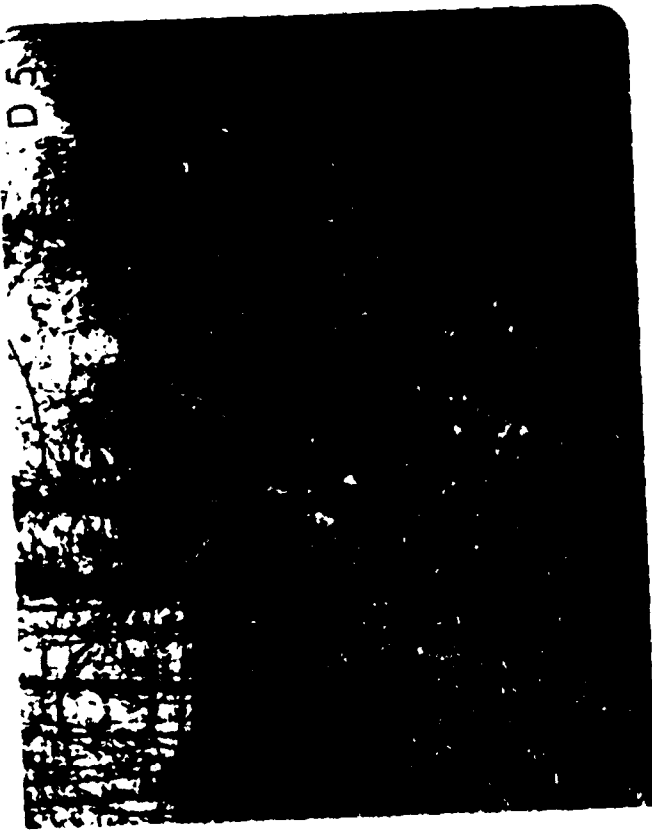
D 6



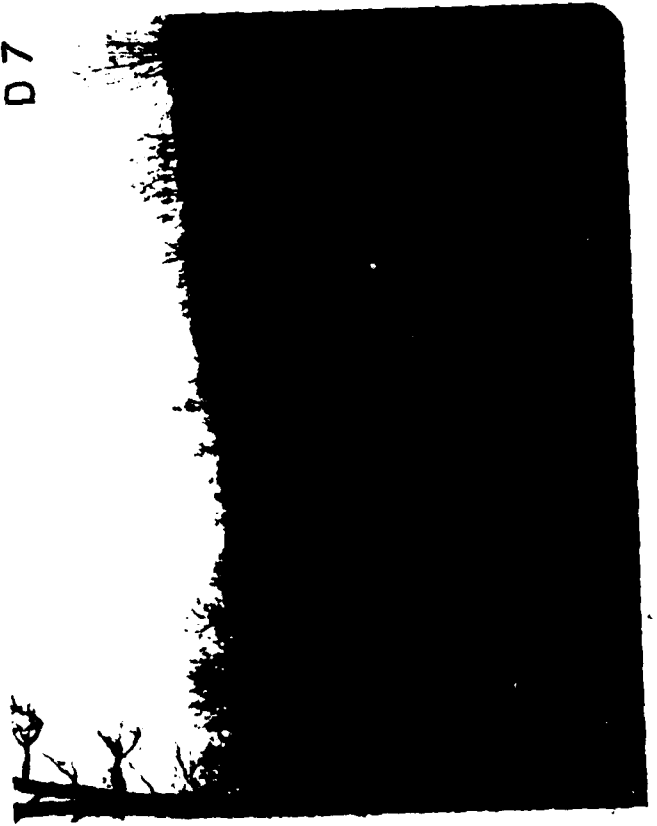
D 8

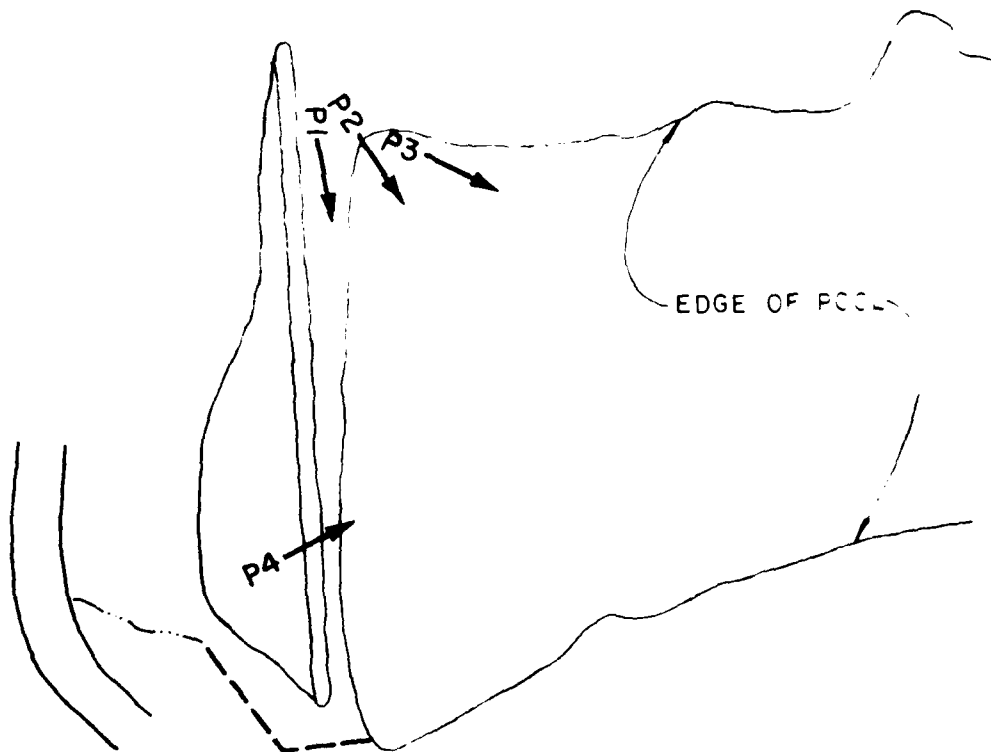
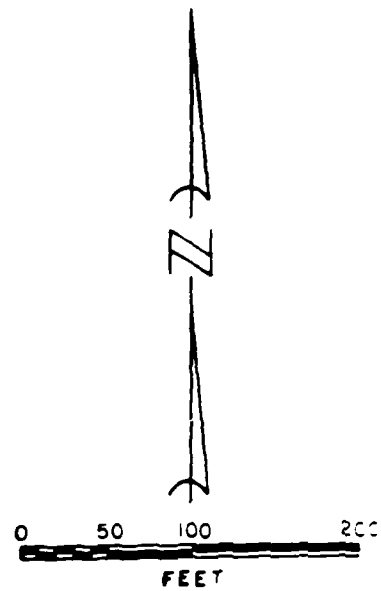


D 5



D 7





**PHOTO INDEX 2**  
FOR  
**PANORAMA**

**LAND OF LAKES DAM**  
**JEFFERSON COUNTY, MO.**  
**DECEMBER 1978**

**PREPARED BY**  
**REITZ & JENS, INC**

P 2



P 4



P 1



P 3



PANORAMA



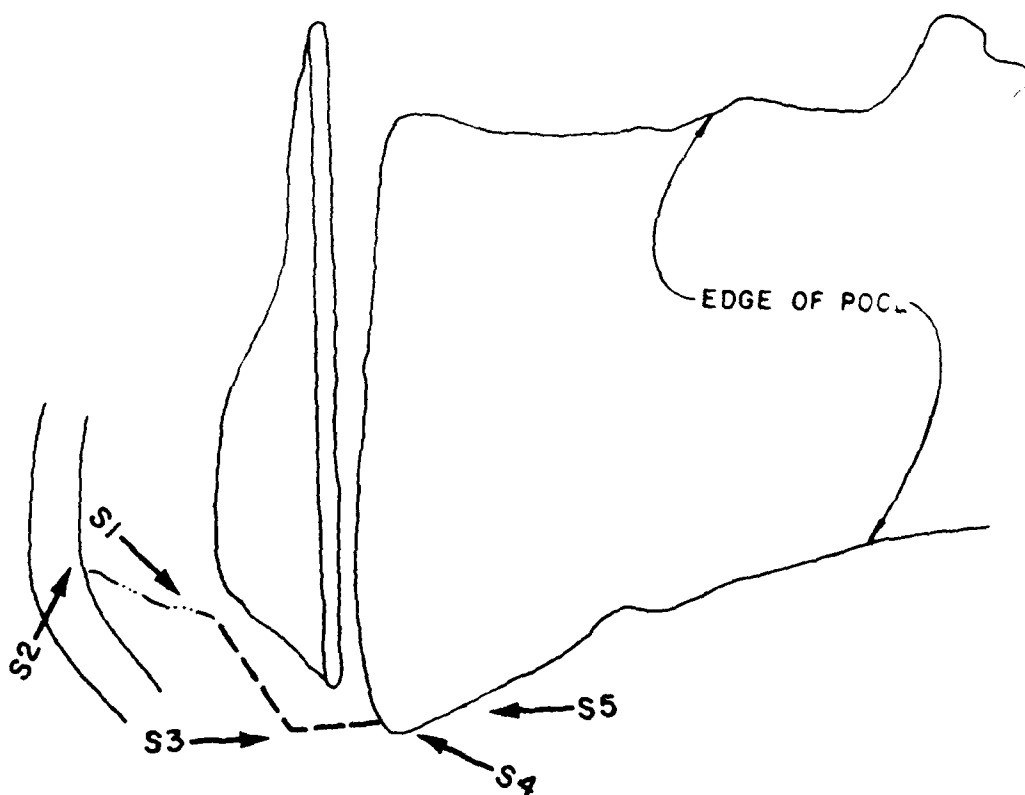
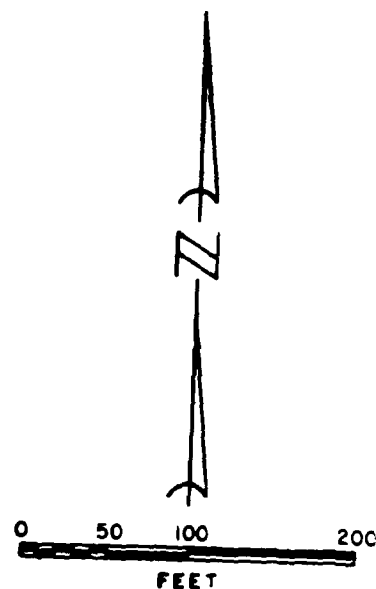


PHOTO INDEX 3  
FOR  
SPILLWAY

PREPARED BY  
REITZ & JENS, INC.

LAND OF LAKES DAM  
JEFFERSON COUNTY, MO.  
DECEMBER 1978

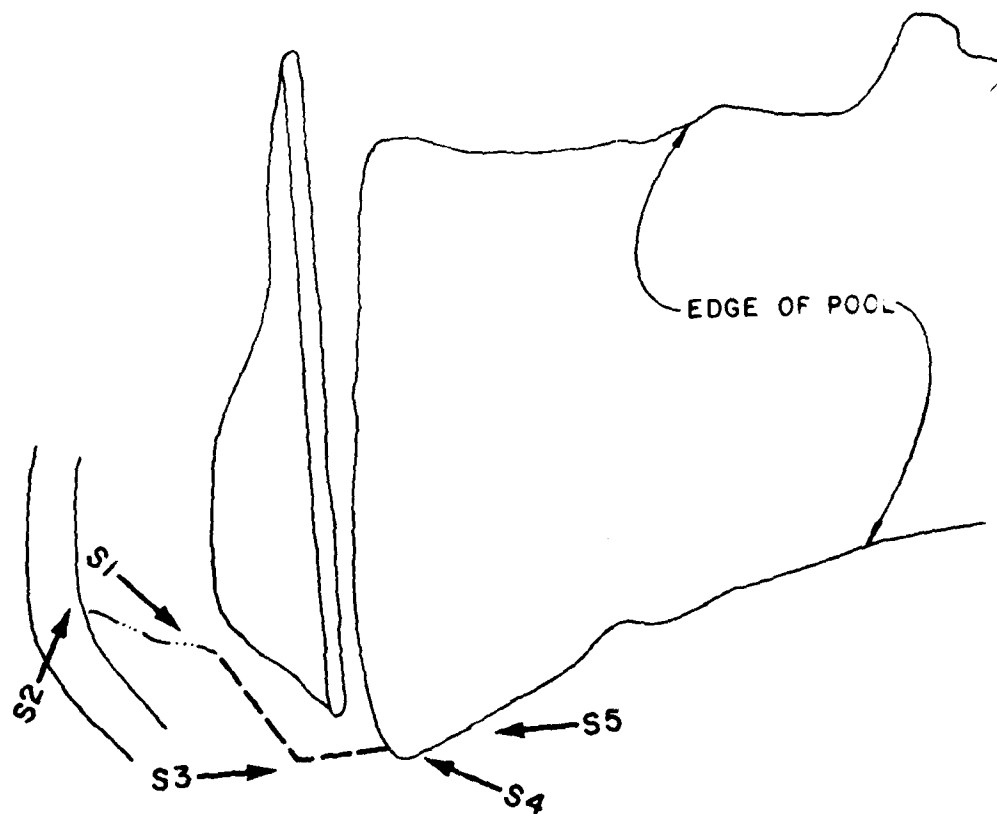
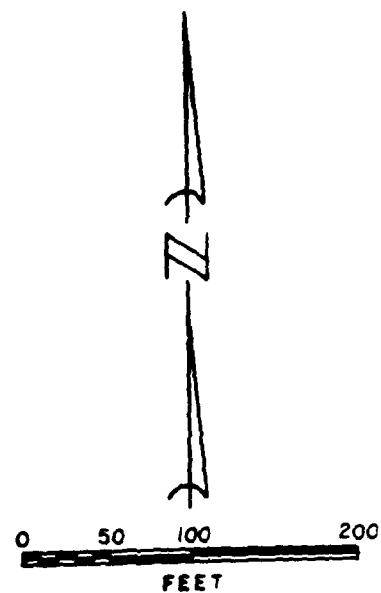


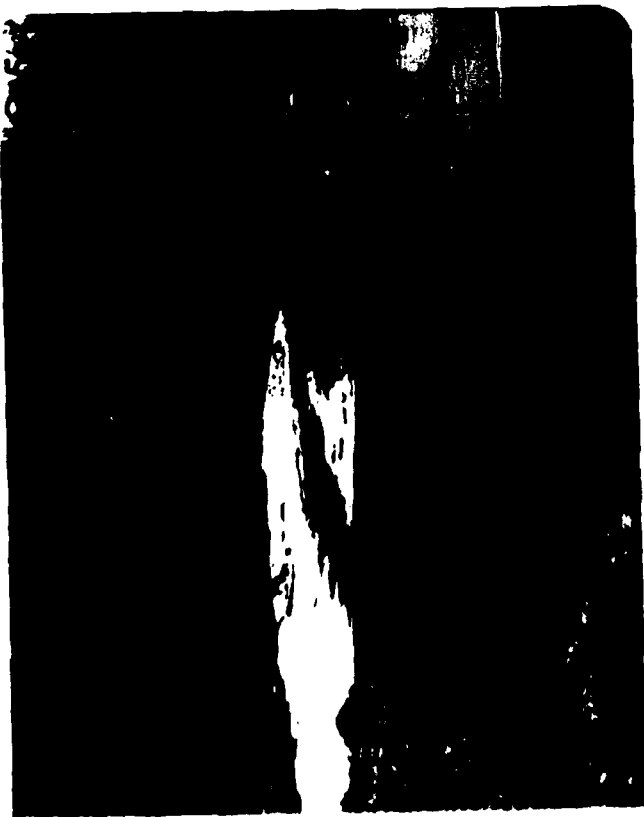
PHOTO INDEX 3  
FOR  
SPILLWAY

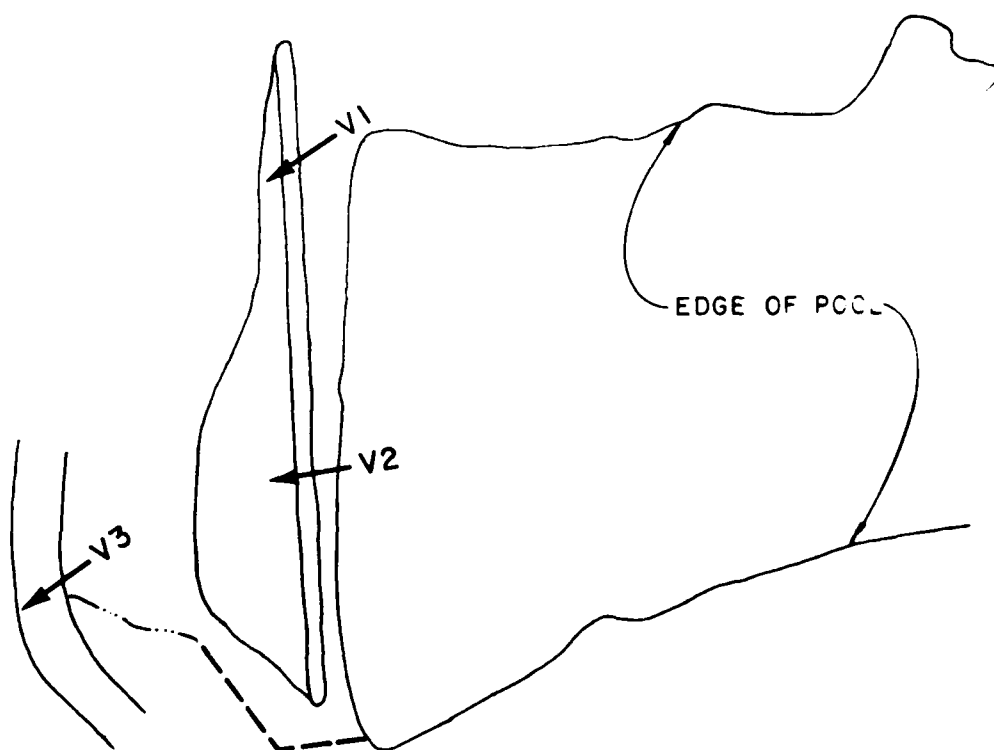
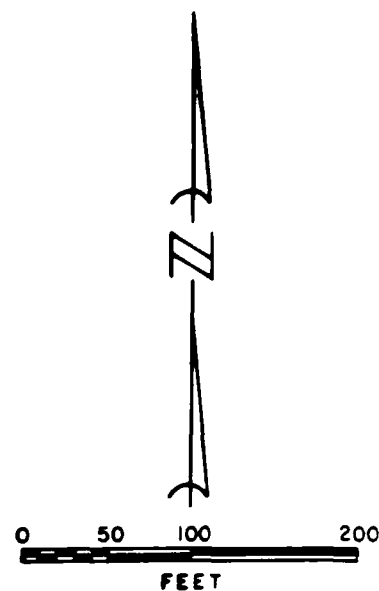
LAND OF LAKES DAM  
JEFFERSON COUNTY, MO.  
DECEMBER 1978

PREPARED BY  
REITZ & JENS, INC.



SPILLWAYS





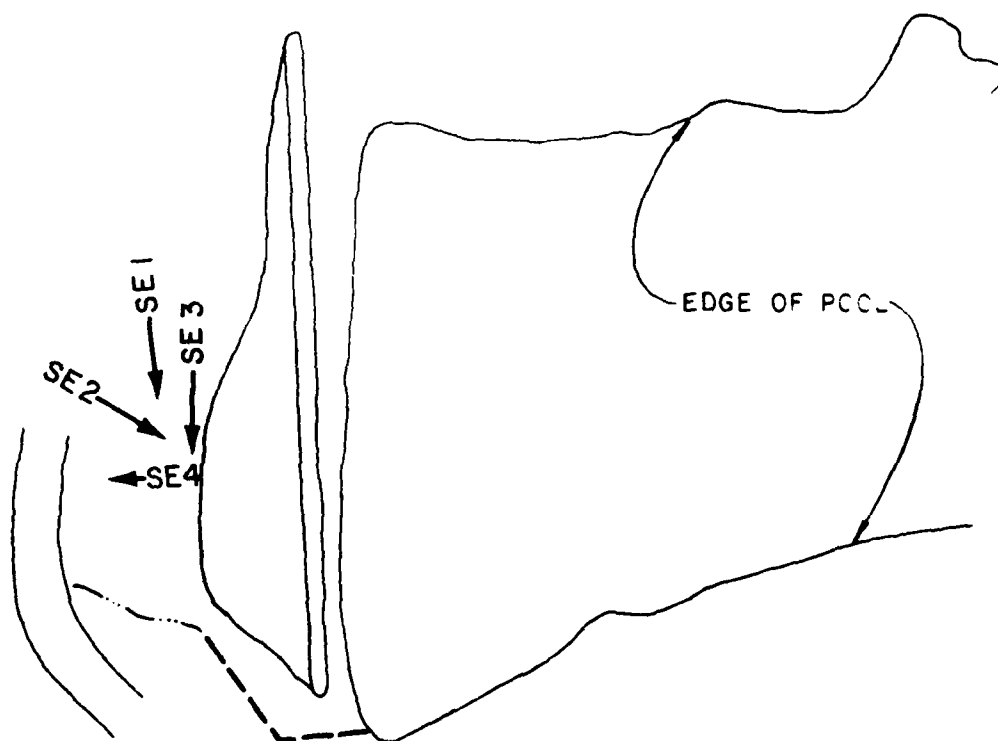
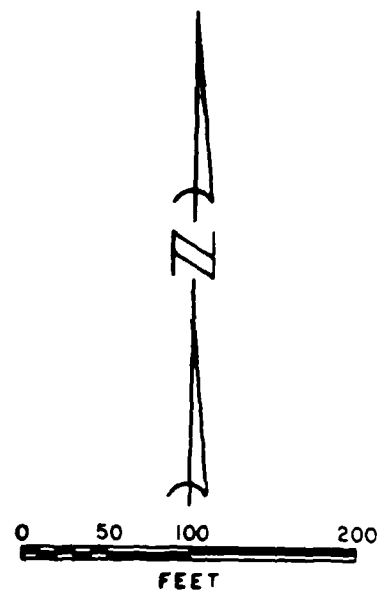
**PHOTO INDEX 4**  
**FOR**  
**VALLEY BELOW DAM**

**LAND OF LAKES DAM**  
**JEFFERSON COUNTY, MO.**  
**DECEMBER 1978**

**PREPARED BY**  
**REITZ & JENS, INC.**



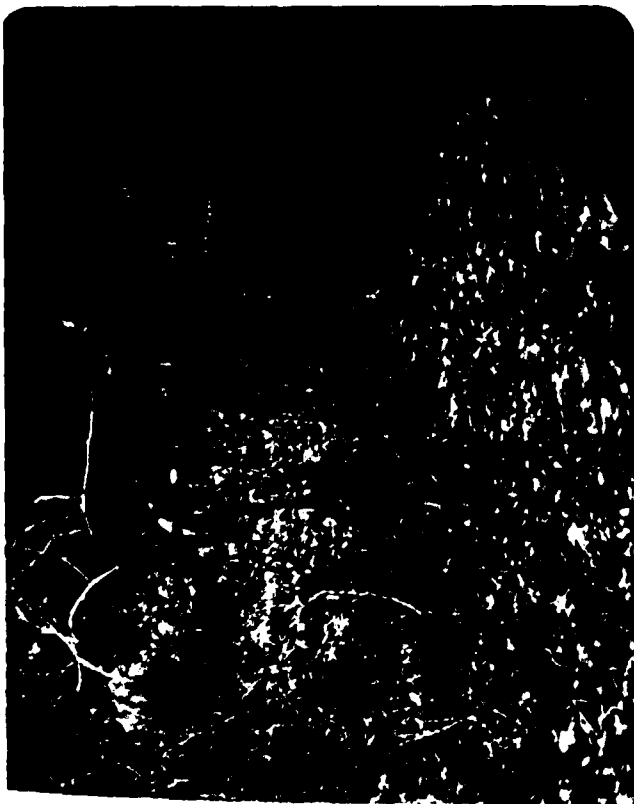
VALLEY BELOW DAM



**PHOTO INDEX 5  
FOR  
SEEPAGE**

PREPARED BY  
REITZ & JENS, INC.

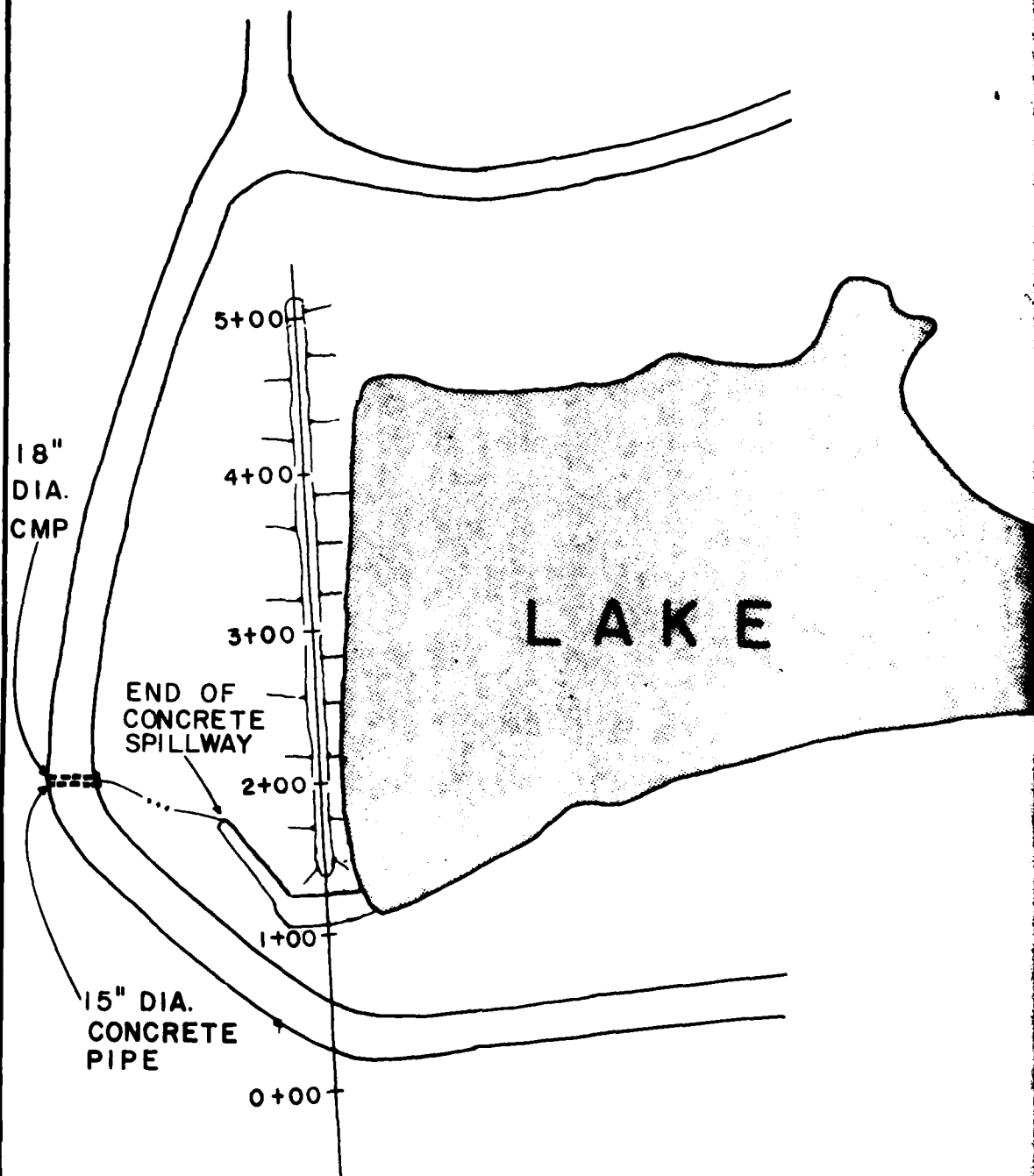
LAND OF LAKES DAM  
JEFFERSON COUNTY, MO.  
DECEMBER 1978



SEEPAGE

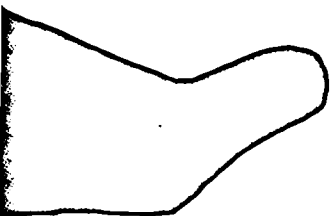


FINAL SURVEY	SURVEYED	DATE
	PLOTTED	
NOTE BOOK NO.	TEMPLATE	
	AREAS CHECKED	



**PLAN OF DAM AND SPILLWAYS**



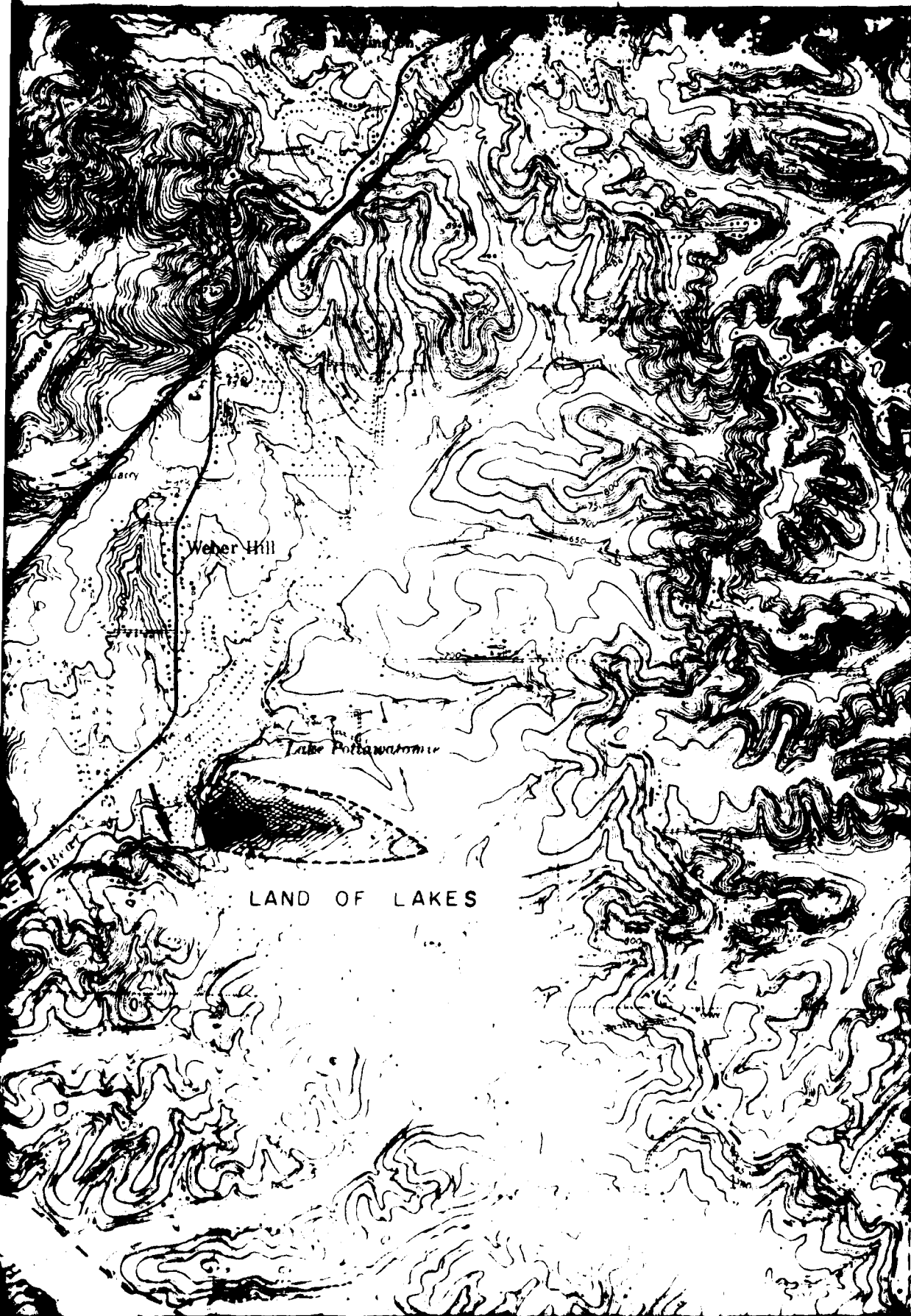


PLAN OF LAKE





WATERS



WATERSHED AND OUTFLOW CHANNEL

0 1000 2000 4000 6000 FT.

## PLAN OF DAM AND SPILLWAYS



ORIGINAL SURVEY		BY	DATE
SURVEYED			
PLOTTED			
TEMPLATE			
AREAS			
AREAS CHECKED			
NO.			

[illegible]

2

100

80

60

200

180

160

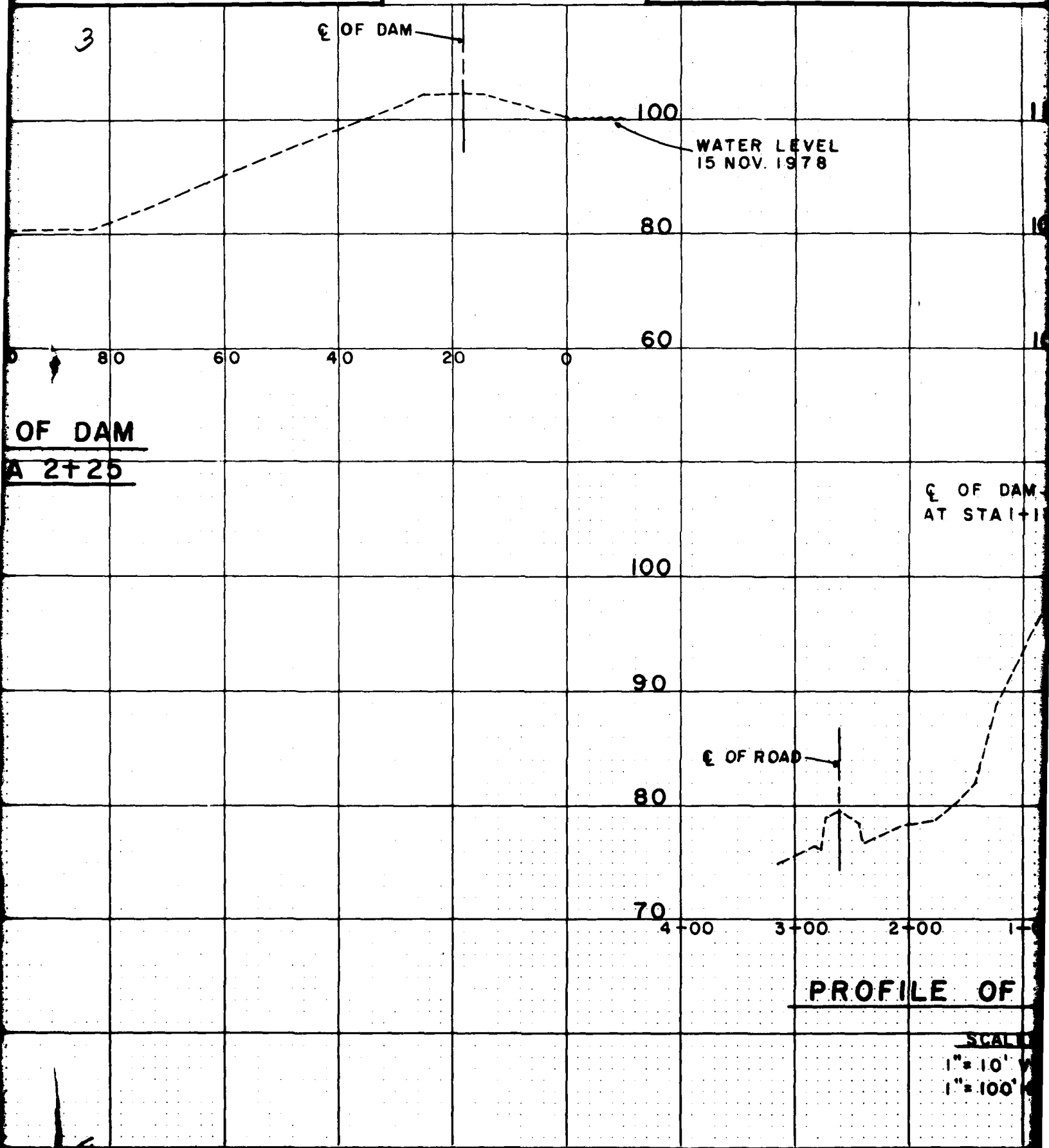
140

120

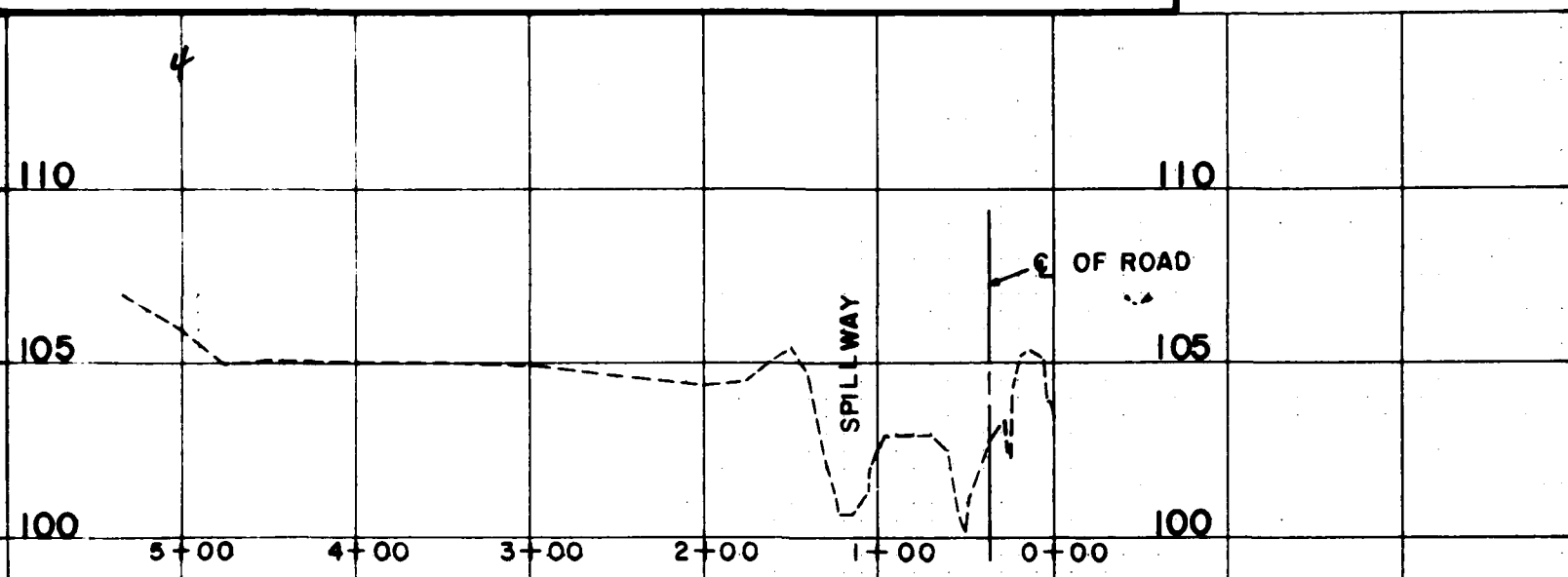
100

℄ OF ROAD

SECTION O  
AT STA

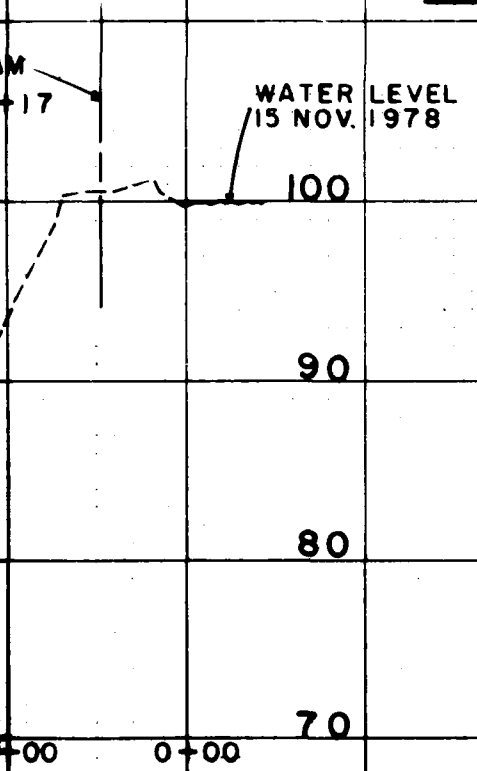


**RESERVOIR AND OUTFLOW CHANNEL**



**PROFILE OF  
TOP OF DAM**

SCALES  
1" = 5' VERT.  
1" = 100' HORIZ.



**LAND OF LAKES**

ADD 435' TO ELEVATIONS SHOWN  
TO OBTAIN APPROX. USGS DATUM

**SPILLWAY**

S  
VERT.  
HORIZ.

<b>PHASE I INSPECTION</b>
COUNTY I.D. NO. 099
JEFFERSON COUNTY, MISSOURI
<b>INVENTORY NO. I. D. 30451</b>
FOR ST. LOUIS DISTRICT, CORPS OF ENGINEERS
REITZ & JENS, INC. CONSULTING ENGINEERS
ST. LOUIS, MISSOURI DECEMBER 1978